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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/531,582	10/12/2005	Shinsuke Harada	270968US2X PCT	1837
22850	7590	06/24/2008		
OBLON, SPIVAK, MCCLELLAND MAIER & NEUSTADT, P.C. 1940 DUKE STREET ALEXANDRIA, VA 22314			EXAMINER KIM, JAY C	
			ART UNIT	PAPER NUMBER
			2815	
			NOTIFICATION DATE	DELIVERY MODE
			06/24/2008	ELECTRONIC

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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<b>Office Action Summary</b>	<b>Application No.</b> 10/531,582	<b>Applicant(s)</b> HARADA ET AL.	
	<b>Examiner</b> JAY C. KIM	<b>Art Unit</b> 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 10 April 2008.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) 1-12, 18, 19 and 22-26 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 13-17, 20 and 21 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 16 May 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \*    c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>8/23/07</u> .   | 6) <input type="checkbox"/> Other: _____                          |

### **DETAILED ACTION**

This Office Action is in response to the Application filed October 12, 2005.

#### ***Election/Restrictions***

1. Applicants' election without traverse of Species II in the reply filed on April 10, 2008 is acknowledged. Claims 13-17, 20 and 21 read on Species II. Claims 1-12, 18, 19 and 22 are withdrawn from further consideration as being drawn to a nonelected Species. Claims 23-26 are withdrawn from further consideration as being drawn to a nonelected invention.

#### ***Claim Objections***

2. Claims 13-16, 20 and 21 are objected to because of the following informalities:

In claim 13, "a first conductivity" and "a second conductivity" should be replaced by "the first conductivity" and "the second conductivity" except on lines 3 and 6.

In claims 14-16, 20 and 21, "a first conductivity" and "a second conductivity" should be replaced by "the first conductivity" and "the second conductivity".

Appropriate correction is required.

#### ***Claim Rejections - 35 USC § 112***

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 13-17, 20 and 21 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Regarding claim 13, it is unclear whether “low concentration” and “high concentration” refer to a density of SiC or an impurity concentration. Claims 14-17, 20 and 21 depend on claim 13, and therefore claims 14-17, 20 and 21 are also indefinite. In the below prior art rejections, it is interpreted that “low concentration” and “high concentration” refer to an impurity concentration.

***Claim Rejections - 35 USC § 102***

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 13 and 17 are rejected under 35 U.S.C. 102(b) as being anticipated by Ueno (US 5,895,939).

Regarding claims 13 and 17, Ueno discloses a silicon carbide semiconductor device (Fig. 3A) (col. 2, lines 66-67) comprising a lower deposition film (bottom layer 32) (col. 8, line 32) of low concentration silicon carbide of a first conductivity type (n-type) formed on a surface of a high concentration silicon carbide substrate (n+ substrate) of the first conductivity type, a high concentration gate region (40) (col. 8, line 31) of a

Art Unit: 2815

second conductivity type (p-type) selectively formed in the lower deposition film (bottom layer 32) so that a first region (arbitrary region between regions 40) of low concentration silicon carbide of the first conductivity type remains in the lower deposition film (bottom layer 32), an upper deposition film (composite layer of 33 and top layer 32) (col. 8, line 37) on the lower deposition film (bottom layer 32), comprising a low concentration base region (top layer 32) of the first conductivity type that is a second region (whole top layer 32) wider than the first region (arbitrary region between regions 40), a high concentration source region (region denoted as n corresponding to 14 in Fig. 1) (col. 7, line 15) of the first conductivity type and a low concentration gate region (33) of the second conductivity type, a gate insulation film (36) (col. 8, lines 52-53) formed on at least a surface of the upper deposition film (composite layer of 33 and top layer 32), a gate electrode (G) formed via the gate insulation film (36), a drain electrode (39) (col. 8, lines 35-36) having a low-resistance contact connection with a backside of the silicon carbide substrate (n+ substrate) of the first conductivity type, and a source electrode (38) (col. 8, line 35) having a low-resistance contact connection with part of the high concentration source region (region denoted as n) of the first conductivity type and the low concentration gate region (33) of the second conductivity type, wherein the upper deposition film (composite layer of 33 and top layer 32) is constituted of silicon carbide (col. 2, lines 66-67).

***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 14-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ueno (US 5,895,939). The teachings of Ueno are discussed above.

Regarding claims 14 and 16, Ueno further discloses that the low concentration gate region (33) of the second conductivity type selectively formed in the upper deposition film has a portion that is in contact with the gate insulation film (36).

Ueno differs from the claimed invention by not showing that the upper deposition film has a thickness within a range of 0.2  $\mu\text{m}$  to 0.7  $\mu\text{m}$  and wherein the low concentration gate region has an impurity concentration higher than  $1 \times 10^{15} \text{ cm}^{-3}$  and lower than  $5 \times 10^{15} \text{ cm}^{-3}$  (claim 14), and an impurity concentration of not higher than  $2 \times 10^{16} \text{ cm}^{-3}$  (claim 16).

Ueno further discloses a silicon carbide semiconductor device (Fig. 1), wherein a low concentration gate region (top or bottom layer 13) (col. 7, lines 11-13) has a thickness from 1 to 10  $\mu\text{m}$  (col. 7, lines 9-10), and an impurity concentration from  $1 \times 10^{16} \text{ cm}^{-3}$  to  $1 \times 10^{17} \text{ cm}^{-3}$ .

Since Ueno teaches a silicon carbide semiconductor device, it would have been obvious to the one of ordinary skill in the art at the time the invention was made that the

thickness of the upper deposition film and the impurity concentration of the low concentration gate region would be about the ranges disclosed by Ueno, because the thickness and impurity concentration can be controlled to achieve a desired device characteristics such as on-resistance and avalanche withstand capability. Further, it has been held that simple substitution of one known element for another to obtain predictable results would be obvious. *KSR International Co. v. Teleflex Inc.* 82 USPQ2d 1385 (2007).

Further regarding claims 14 and 16, the claim is prima facie obvious without showing that the claimed ranges of the thickness and impurity concentration achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious).

Regarding claim 15, Ueno differs from the claimed invention by not showing that the low concentration base region of the first conductivity type has a lower impurity concentration than the high concentration gate region of the second conductivity type.

Ueno further discloses a silicon carbide semiconductor device (Fig. 1), wherein a low concentration base region (12) (col. 7, lines 8-9) of a first conductivity type (n-type)

Art Unit: 2815

has an impurity concentration from  $1 \times 10^{15} \text{ cm}^{-3}$  to  $1 \times 10^{16} \text{ cm}^{-3}$ , while a high concentration gate region (20) has an impurity concentration  $1 \times 10^{16} \text{ cm}^{-3}$  to  $1 \times 10^{19} \text{ cm}^{-3}$  (col. 7, lines 30-32).

Since Ueno teaches a silicon carbide semiconductor device, it would have been obvious to the one of ordinary skill in the art at the time the invention was made that the low concentration base region and the high concentration gate region have impurity concentrations about the range disclosed by Ueno, and therefore the low concentration base region of the first conductivity type has a lower impurity concentration than the high concentration gate region of the second conductivity type, because the impurity concentration can be controlled to achieve a desired device characteristics such as on-resistance and avalanche withstand capability. Further, it has been held that simple substitution of one known element for another to obtain predictable results would be obvious. *KSR International Co. v. Teleflex Inc.* 82 USPQ 2d 1385 (2007).

9. Claims 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ueno (US 5,895,939) in view of Fukuda et al. (US 2002/0047125). The teachings of Ueno are discussed above.

Regarding claims 20 and 21, Ueno differs from the claimed invention by not showing that in terms of crystal Miller index the surface of the silicon carbide substrate of the first conductivity type is a plane that is parallel to a (11-20) plane (claim 20), or parallel to a (000-1) plane (claim 21).



Fukuda et al. disclose a silicon carbide semiconductor device (Fig. 1), wherein the silicon carbide substrate (1) (lines 1-2 of [0052]) has a (11-20) or a (000-1) surface (claims 17-23) (Please note that (0001) on line 2 of [0052] is a typo of (000-1)).

Since both Ueno and Fukuda et al. teach a silicon carbide semiconductor device, it would have been obvious to the one of ordinary skill in the art at the time the invention was made that the silicon carbide substrate disclosed by Ueno may have a (11-20) or (000-1) surface, because these two surface orientations are well-known and commonly used surface orientations of a hexagonal SiC substrate for fabricating a silicon carbide semiconductor device. Further, combining prior art elements according to known methods to yield predictable results would be obvious. *KSR International Co. v. Teleflex Inc.* 82 USPQ 2d 1385 (2007).

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JAY C. KIM whose telephone number is (571)270-1620. The examiner can normally be reached on 7:30 AM - 5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2815

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Matthew C. Landau/  
Primary Examiner, Art Unit 2815

/J. K./  
Examiner, Art Unit 2815

June 13, 2008